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Science and Policy: Photochemical Oxidants and Acid Bearing Species

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As scientific findings continue to pour in, pointing to one potential environmental crisis after another, society has become increasingly concerned and confused. It is clear that progress has been made in improving many aspects of the quality of our environment since the initial enactment of environmental legislation in the early 1970's. In spite of these improvements, many environmental problems persist and new and sometimes unanticipated problems have surfaced. Two recent examples being the stratospheric ozone depletion and climate change issues. The focus of this talk will be on the subject of photochemical oxidants and acid bearing species, considering the state of its science, existing environmental policy and regulation, and associate decision making issues.

Air quality management, through the implementation of air quality and emission standards, has been the corner stone of the Clean Air Act legislation within the United States. The air quality management framework is based on the concept that quantitative links between pollutant emission and ambient air quality can be developed which provide viable guidance as to the most effective and efficient pollution abatement strategies to meet existing air quality standards or to consider future policy options for the mitigation of a pending environmental problem.

As our understanding of attendant atmospheric processes governing the transport, transformation and disposition of pollutants evolves, so does our ability to prescribe the predictive accuracy of models which integrate these processes to simulated the fate and transport of pollutants in the atmosphere. But, our understanding is incomplete, as is our ability to precisely monitor the state of the atmosphere at all times and in all space. As a result, models must be viewed as imperfect tools providing imperfect information (predictions). This fact should not be construed as a condemnation of air quality simulation modeling or disincentive for their use in regulatory air quality management. It is meant to convey rather that the limits on our ability to predict the chemical and physical dynamics of atmospheric systems are real and becoming more quantifiable with our expanding knowledge. The development of quantitative measures and the effective utilization and communication of model uncertainty must be at the heart of the development effort so as to better serve the policy and regulatory decision making communities.

Uncertainty in science is generally perceived as relating to those aspects of science which as yet are not completely understood and await only the necessary research to resolve this lack of understanding. But in actuality this is not what uncertainty in science really represents. Though the quest of science is absolute "truth" (complete understanding), the precision of information about processes and the characteristic parameters

for generating scientific understanding of observed phenomena is variable and finite.

In many instances the quantification of scientific uncertainty or lack thereof becomes the manipulated factor for contending interests to provide a rationale for decisions they prefer. Scientists, to some extent exacerbate this contention by not maintaining total objectivity in presenting factual data and allowing their value system to affect their scientific judgment. This can occur subtly and unknowingly or it may be done quite blatantly.

In any event the scientist's role is to provide his best objective and factual judgement on the nature and magnitude of the uncertainty associated with the scientific issues that have a direct impact on the public policy choices. The ramifications of the scientific uncertainty with regard to sorting out what public policy choices should be made is not part of the scientist's judgmental process, but the responsibility of the policy analyst/decision maker.

Over and over again science intensive public policy disputes surface where the scientific community is concerned that political contentions distort scientific advice to meet preconceived policy agendas, while political concerns believe that the scientist tend to over-interpret scientific analyses to either distort public policy disputes or attempt to preempt or unduly influence the public policy/political analysis process. In the context of this discussion the non-linearity issue with respect to sulfur control in the acid deposition debate and the current controversy on NO_x control with regard to strategies for meeting the ozone standard in the United States will serve as illustrative examples.

The quantification of the precision and accuracy of mathematical models developed to simulate the distribution and fate of chemical substances emitted into the atmosphere can be achieved if adequate data bases are developed for operational and evaluative purposes. Uncertainty analysis techniques continue to evolve and more efficient and effective techniques are likely to be developed, but present studies are limited more by the lack of evaluation data sets than uncertainty analysis approaches or methodologies.

The utilization of this information and future refined information in the regulatory decision making process as a result of the application of these modeling tools for strategy development and emission control decisions has not been attempted. This talk articulates some of the issues associated with incorporating this knowledge into the decision making process and provides some conceptual ideas as to how this might be approached operationally.